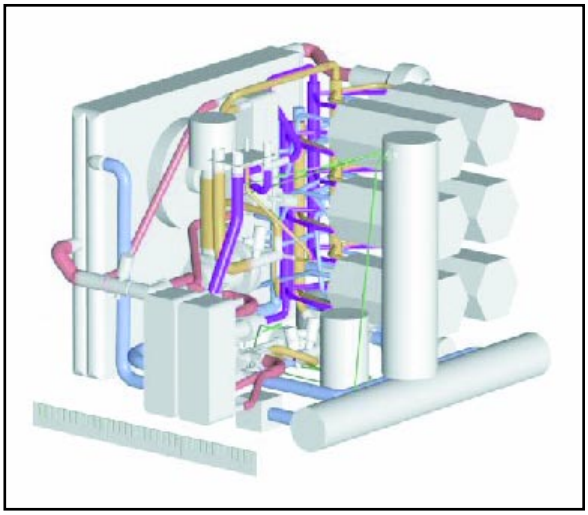
Fuel cell stack demonstrates high power density and tolerance to high carbon monoxide concentrations

OAAT ACCOMPLISHMENTS

Integrated 50-kW Fuel Cell Stack System

Challenge

To succeed in the marketplace, fuel cell propulsion systems must offer increased fuel efficiency and near-zero emissions with performance and costs comparable to conventional internal combustion engine propulsion systems. At the heart of a fuel cell system is the fuel cell stack, composed of individual, series-connected fuel cells, in which the actual electricity-generating reaction takes place. For automotive applications, fuel cell stacks have to meet aggressive performance parameters, such as for power density, efficiency, cost, durability, and tolerance to impurities, such as carbon monoxide, in the fuel reformate.



Conceptual 50-kW power plant.

Technology Description

The Department of Energy (DOE) entered into a cost-shared partnership with Honeywell Engines and Systems to build and test an integrated 50-kW polymer electrolyte membrane (PEM) stack system with subsystems for air, water, and thermal management. Overall system performance depends greatly on successfully integrating these subsystems with the fuel cell stack. The phased program involves fabricating and testing three generations of PEM fuel cell stacks (10-kW), leading up to the final 50-kW system.

Accomplishments

Honeywell's fuel cell stack demonstrated tolerance to carbon monoxide (CO) concentrations greater than 200 parts per million in the reformate without appreciable performance loss. This meets DOE's technical target for CO tolerance, and is compatible with typical CO levels resulting from gasoline reformate clean-up systems (<50 parts per million). A 10-kW stack has consistently shown excellent performance for 250 hours while operating on reformate containing carbon monoxide. Uniform voltage distribution, a specific power of 0.87 kW/kg, and a power density of 1.6 kW/liter were also achieved, demonstrating the performance necessary to meet stack system technical targets.

Benefits

A fuel cell-powered vehicle is up to twice as efficient and has very low emissions compared to a conventional vehicle with a gasoline-fueled internal combustion engine. Depending on the fuel feedstock, a fuel cell-powered automobile can even attain the "zero emission" standards normally associated with an all-electric vehicle. The highly efficient technology also leads to very low emissions of carbon dioxide, while the ability to operate on a variety of liquid hydrocarbon fuels promotes fuel diversity and increased national energy security.

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Future Activities

Researchers will focus on developing and assembling a 50-kW PEM fuel cell stack system brassboard, or working assembly, including identifying and integrating optimal air, water, and thermal management subsystem components for the 50-kW system to replace the oversized, off-the-shelf components currently in use.

Partners in Success

- Argonne National Laboratory
- Honeywell Engines & Systems